V. P. P. 47.

U. S. DEPARTMENT OF AGRICULTURE.

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FARMERS' BULLETIN No. 30.

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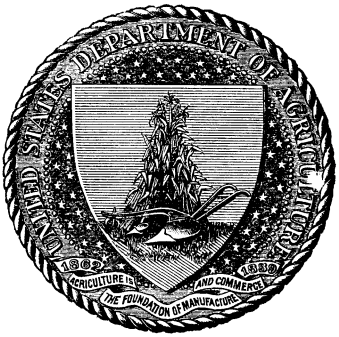
# GRAPE DISEASES

ON THE

# PACIFIC COAST.

BY

NEWTON B. PIERCE,
DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY.

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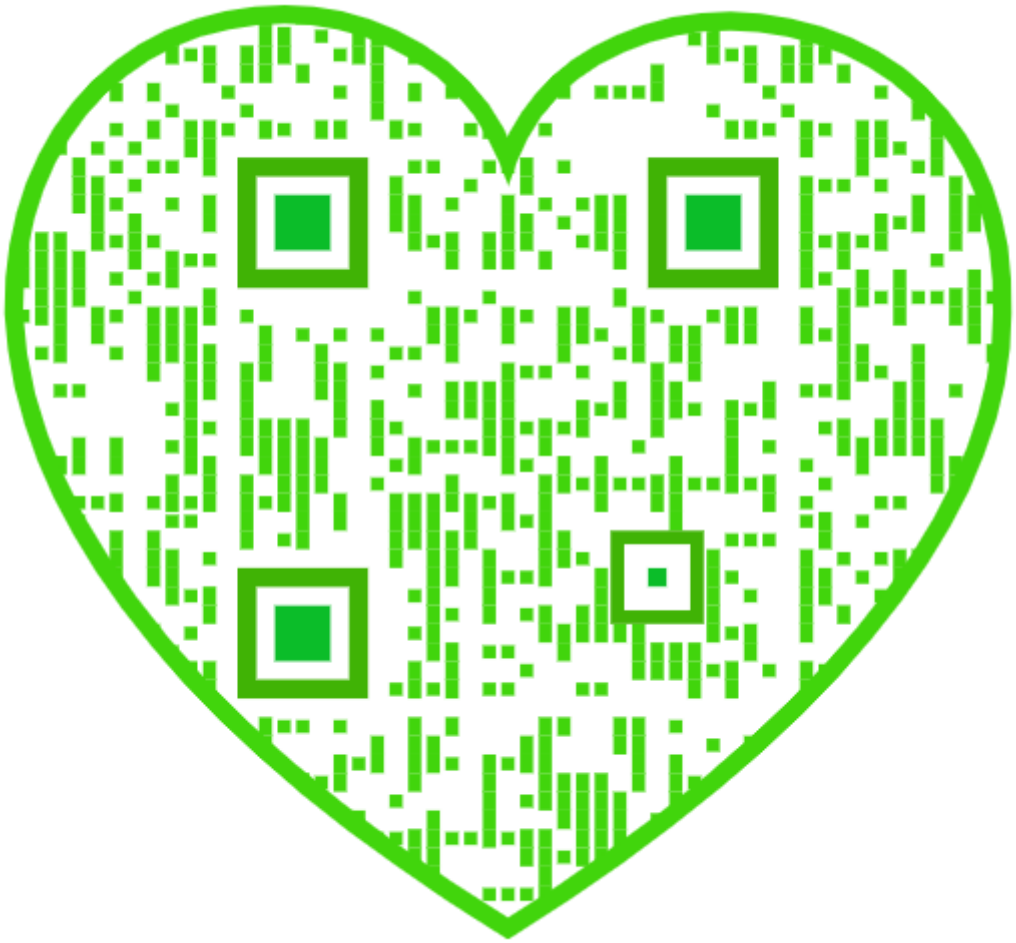

# LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY,
*Washington, D. C., July 16, 1895.*

SIR: I have the honor to transmit herewith Farmers' Bulletin No. 30, Grape Diseases on the Pacific Coast, prepared by Mr. Newton B. Pierce, assistant in this Division. The bulletin brings together in a brief, practical way the main facts in regard to three of the principal diseases affecting the grape in California and other Pacific Coast States.

Respectfully,

B. T. GALLOWAY,
*Chief of Division.*

Hon. CHAS. W. DABNEY, Jr.,
*Acting Secretary of Agriculture.*

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# GRAPE DISEASES ON THE PACIFIC COAST.

## INTRODUCTION.

More than one-half the grapes of the United States are grown on the Pacific Coast, California alone having approximately 200,000 acres of vines. Most of the varieties grown in this region are derived from a single species of grape, *Vitis vinifera*, which is believed to be a native of Asia, but which has been so long and so extensively cultivated throughout Europe that it has become widely known as the European vine. The varieties in the eastern United States have, for the most part, originated from native North American species, but will grow under almost all the different climatic conditions prevailing in this country.

The root louse (*Phylloxera*), and the fungous diseases known as downy mildew, powdery mildew, and black rot are much more severe on European than on native varieties. *Phylloxera*, so common upon our wild vines, where its injuries are slight, becomes a deadly parasite when transplanted to the roots of the European grape. The older vineyards of France have been largely destroyed by this pest, but are now being restored by grafting the tender European varieties upon the roots of hardy wild vines obtained from the United States. Powdery mildew (*Oidium*) and downy mildew (*Peronospora*), which do little damage to our native vines, have swept over European vineyards like fire. One reason why the cultivated European vines are more susceptible to the enemies mentioned than American species is probably owing to the long cultivation and continued selection of the more fruitful rather than the more hardy European varieties, the result naturally being a stock of high-bred but tender plants.

From the preceding remarks it will be seen that the main reason why vine diseases are more destructive on the Pacific than on the Atlantic Coast is because the European or tender varieties are grown in the former and the American or hardy vines in the latter part of the United States.

## CALIFORNIA VINE DISEASE.

Several vine diseases occur on the Pacific Coast which cause heavy losses. The most serious one, however, is the California vine disease, which has already killed more than 30,000 acres of the most thrifty and

productive vineyards. This disease may be placed among the most destructive as well as the most obscure of all plant maladies. Considering its injurious nature, the obscurity of its cause, and the extent of its ravages, it may be classed with peach yellows. For a century prior to the appearance of this disease in the localities where it now prevails, the most susceptible Mission varieties had been grown with the greatest success. As near as can be learned, the disease first appeared in 1884; in 1885 many vines were killed, and in 1886 extensive vineyards were destroyed by it in the vicinity of Anaheim, Cal. From this time on the disease spread, until now whole vine-growing regions are denuded and the disease is at work 50 miles from the point where it began its ravages. Up to the present time, as before stated, 30,000 acres of vines have been destroyed, causing a direct and indirect loss of not less than $20,000,000.

FIG. 1.—Leaves of Muscat of Alexandria attacked by the California vine disease.

The effects of the disease are seen the first season on the foliage of the vine, but by the second season a reduced growth of the cane is apparent. Taking the Muscat of Alexandria as an illustration of the behavior of the disease, when the leaves of this variety are attacked small yellow spots appear in the tissue between the main veins; as these spots enlarge they often unite, forming yellow strips, which broaden and die at the center (fig. 1). Eventually there is a well-marked brown stripe of dead tissue, bordered by yellow on each side, leaving only a narrow band of green tissue along the veins. After this the leaves fall, and as a result the immature portions of the canes turn black and die. The next season the growth is short. Often the color of the foliage is

normal in the spring, becoming spotted during the heat of summer, after which the premature fall of the leaves and the death of the canes ensue as before. The following spring the vine may fail to put forth new growth, or it may grow until the heat of the summer and then die. This is a typical illustration of the progress of the malady, which works in many ways. In some instances the diseased vines appear perfectly healthy up to the time of the vintage, when they suddenly die; in other cases they live from three to five years.

The roots also show the diseased state of the vine at an early period; the growing points shrink and the rootcap begins to decay. This decay is most apparent in the parenchyma or soft tissue surrounding the wood bundles of the smaller roots. The soft parts rot to such an extent that the cortical portion of the root may be easily stripped from the wood. This decay progresses until nearly the whole root system is involved.

When the malady first appears in a vineyard its attacks seem sporadic. The disease will show on a vine here and there or on several vines in one section of the vineyard where some unfavorable soil condition weakens the stocks. Gradually other vines become affected, and the disease continues to progress and its virulence becomes more marked, until finally the vineyard is worthless.

Some varieties of vines are much more resistant to the California malady than others, but there is no variety, so far as observed, which can wholly withstand it. Wild vines growing in the mountain canyons have been killed by it, and the Eastern vines appear to be only partially resistant, many of them succumbing to the disease. The difference in the hardiness of varieties has often been shown in a striking manner. The Mission vine is one quite easily affected; the Muscat, on the contrary, yields more slowly to the disease. When the malady first appeared there were thousands of acres of fine Muscat and Mission vineyards in the region around Anaheim; in the immediate neighborhood of Anaheim chiefly Mission grapes were planted, which were used for making wine. Scattered among the wine vineyards, however, were numerous vineyards of raisin grapes of the Muscat of Alexandria variety. It was remarked by all that the disease at first killed only the wine or Mission grapes, the raisin grapes remaining apparently healthy. So marked was the destruction of the wine grapes and the apparent immunity of the raisin grapes that many regarded the disease as a judgment on the wine traffic. However, the year after the disease appeared among the Mission grapes the raisin grapes showed disease and in the end the raisin growers were no better off than the wine makers.

Studies of this malady have revealed the fact that cuttings from diseased vines are themselves diseased, and that the degree or amount of disease in the cutting is proportionate to the degree or stage of the disease in the parent vine. Cuttings from diseased vines may root well

and produce a fine, healthy-looking top, especially in the spring, but as the heat of the season approaches these young vines show disease, dying earlier or later, according to the length of time the parent vine has been affected. The disease is also found to be cumulative in its action. The longer the vine lives the more obvious becomes its unhealthy condition, the vitality of the plant being gradually overcome.

When the disease was most virulent it was learned that vines grown from healthy cuttings procured from outside of infected districts would also contract the malady and die. As time passed, however, it lost much of this virulence, and the setting of healthy cuttings can now be recommended with more confidence than formerly. Numerous vineyards are growing and bearing well which were started from healthy vines, while the disease is still apparent in many vineyards set from cuttings procured within the infected district. To those who contemplate planting new vineyards within the infected district it may be of value to know that the vineyards of the great San Joaquin Valley can be recommended as a convenient and proper source of supply for healthy cuttings. Cuttings should not be obtained within the limits of the infected district unless made from young vines grown from healthy stock.

## POWDERY MILDEW.

Powdery mildew is one of the most common fungous diseases of the vine. It is present in nearly all the grape-growing countries of the world, but is most destructive in warm and humid localities, for instance, near the sea. In California it was known as early as 1860 or 1861, and is now present in most of the vineyards along the coast. This fungus grows on the canes, the leaves, and the fruit; its greatest injury, however, is done to the latter, as it checks the growth of the berry, either entirely or on one side, the parts affected becoming hard. When one side only is attacked the further growth of the berry causes the dried surface to burst open, wholly destroying the fruit.

Powdery mildew has two kinds of reproductive bodies or spores, one for rapid summer distribution and the other to preserve the fungus over winter. In the warmer portions of the Pacific Coast the summer spores are the only ones commonly observed. When abundant they give a whitish, powdery appearance to the parts of the host affected, and it is from this appearance the fungus derives its name. These white summer spores are called conidia. The winter fruits are produced on the approach of cold weather, and, unlike those of summer, are thick-walled, blackish bodies, securely inclosing and protecting the delicate spores. They are more or less abundant according to the climate where the vine is grown.

This disease can be easily treated, owing to the fact that the vital portions of the fungus grow upon the surface, making possible the use of remedies as well as preventives. A fungicide may be applied after

the vine is affected and still serve to check the progress of the disease. Sulphur is the agent used in nearly all cases, the fumes destroying the tender spores and vegetative organs. Throughout the warmer valleys of the coast it is the practice of some growers to place the sulphur upon the hot ground at the windward side of the vines. The heat of the sun causes the fumes to rise and pass through all portions of the vine above ground. Other growers scatter the dry sulphur upon the crown of the vine by means of loosely woven sacks or from the perforated bottoms of tin cans, two rows of vines being sulphured at once by a man passing between them. In districts subject to the disease it is found desirable to apply the sulphur once before the grapes are in bloom and again when the fruit is set. The vineyard should be sulphured as often as the mildew begins to appear to an injurious extent. No definite rule for treatment can be laid down, as seasons vary and the vines are much more subject to the disease in some localities than in others.

In the treatment of vines trained long and not pruned back, as is the common practice on the Atlantic Coast, an early spring spraying of the vines with bordeaux mixture may aid in keeping down this mildew, as it will prevent the infection of new growth from the winter spores remaining upon the vine. This early spring spraying will also aid in preventing the infection of the vine by spores of other fungi.

## COULURE.

The word coulure is taken from the French, and signifies the falling of grape flowers and the imperfect growth of grapes. It is a trouble in which the vine growers of the entire country, especially those of the Pacific Coast, are deeply concerned. The causes of coulure are many, and some which exist on the Pacific Coast are not commonly found in the Eastern States. The greatest and most frequent losses from this disease occur in the raisin-growing districts of California and Arizona, and arise mostly from climatic causes. It has caused much greater damage in raisin than in wine vineyards. This is true both in California and Arizona, and in Arizona it is said a full first crop of raisin grapes has not been obtained for twelve years or more. The total loss to the coast from coulure can not be accurately estimated, but it certainly amounts to many millions of dollars.

There are two varieties of raisin grapes proper grown in California. The oldest variety is the Muscat of Alexandria. It is the standard and is probably the highest-bred raisin grape in existence. It has the softest and most beautiful foliage of any vine, and the flavor of its fruit is the standard by which all raisin grapes are estimated. It bears the name of one of its ancient homes, Alexandria, in Egypt, where it was cultivated at least two thousand years ago and where possibly it may have originated. The other variety of raisin grape extensively grown in California is the Muscatel Gordo Blanco (fig. 2), a variety originally

brought from Spain and very closely allied to the Muscat of Alexandria. It is probable that this is only a seedling of the Muscat, but is somewhat more hardy than the parent plant.

An examination of the situation in the raisin districts of California, especially in the San Joaquin Valley, showed that the dropping of the fruit was due in the main to unfavorable climatic conditions at or about the time when the first-crop grapes were in bloom. Both the Muscat of Alexandria and the Muscatel Gordo Blanco varieties are so highly bred and so tender that cold or other unfavorable climatic conditions will prevent the fecundation of the flowers. Both are prolific bearers but owing to sudden changes of temperature, cold weather, and hard winds, which are not infrequent when the first crop grapes are in bloom, it is not uncommon for more than one-half of the bloom to fail to set fruit, as shown in fig. 3. The loss which this causes is twofold. The first-crop bunches are generally the largest and bear the finest and first-ripening grapes, hence if they are injured or lost it causes a great reduction in the output of the vines and at the same time lowers the quality. It is, in fact, the first-crop bunches which raise the grade and price by making the London layers. Further than this, the first-crop grapes ripen much earlier than the second crop, and hence may be cured in the sun before the fall rains.

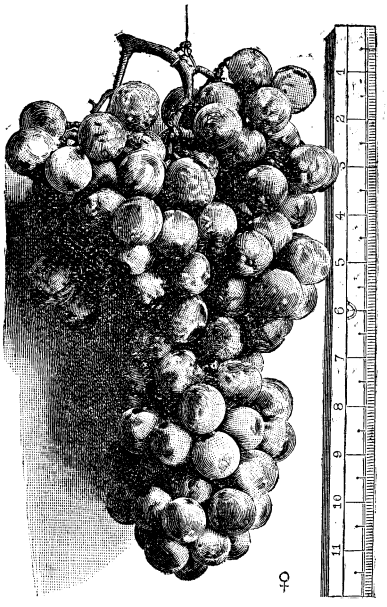

FIG. 2.—Bunch of Muscatel Gordo Blanco grapes.

To save the first crop of raisin grapes from injury is therefore the important problem. As the main injury is done when they are in bud and bloom, that period is the one with which we have to deal. As a result of investigations it was ascertained that if the first bloom could be delayed until the weather became fine the injury would not occur, and that if protected from the cold or from other unfavorable atmospheric conditions the crop could be saved. These facts indicate that it is the tenderness of the plant which renders it subject to injury. To overcome this weak point in the two varieties mentioned, the writer, in the spring of 1893, commenced a series of experiments in crossing these varieties with the Malaga. This California Malaga is a vine of exceedingly thrifty growth and is hardy throughout. Its root system will support the vine in sandy soils, where the Muscat would die. Its leaves are heavy and large, and the work of

leaf hoppers does not cause them to fall, as is the case with the Muscat, hence no grapes are allowed to sunburn, a source of large losses. Further than this, the fruit makes an exceedingly good raisin, though not equal to the Muscat or Muscatel. The bunches are large and almost wholly first crop, and the berries are of good size. The vine always sets a full bunch. Besides the qualities above mentioned, the Malaga is free from coulure; its entire strength goes to the first-crop bunches; the bunches and berries are large and of good quality; the color is light; and the vigor and habit of growth, both of root and top, are all that could be desired.

The work of Millardet and De Grasset has shown that in crosses among vines the variety or species used for pollination is the one transmitting its hardiness, hence in the experiments undertaken in crossing the Malaga and Muscat the Malaga was chosen as the pollinating variety.

Arrangements were made with Mr. L. S. Chittenden, of the Lucerne vineyard, Hanford, Cal., to furnish the vines required for the work, and to assist in the growing of the seedling vines when the cross was made. The facilities tendered by Mr. Chittenden and the other owners of this vineyard could not be surpassed. The first cross was made in the spring of 1893 between the Malaga and Muscatel. Many hundreds of Muscatel flowers were emasculated and pollinated with Malaga pollen. The cross was effective and several hundred fertile seeds were obtained. These were sown with care in the spring of 1894 and at present a number of plants are being reared. The work of the spring of 1894 was still more extensive, between 16,000 and 20,000 grape flowers being emasculated and cross-pollinated. The crossing was not confined to two varieties only, but several of the most desirable combinations were made, and at this writing the grapes are properly maturing.

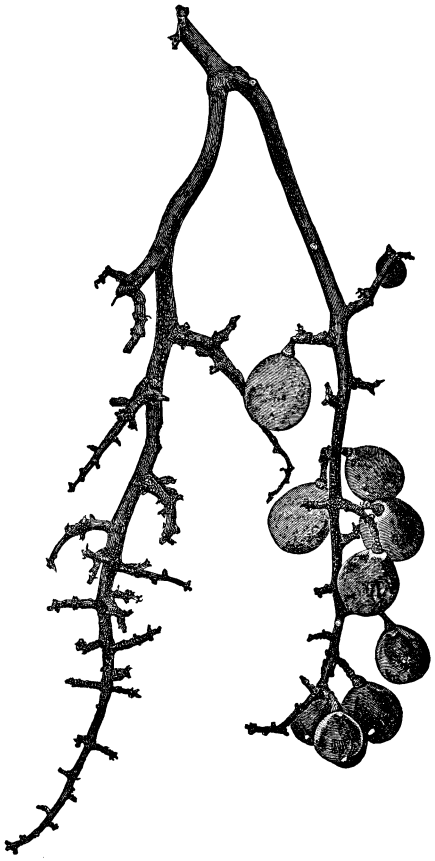

FIG. 3.—Bunch of grapes showing effects of coulure.

It is our purpose to obtain as large a number of these crossed vines as possible, and when grown to maturity to select those plants which inherit in the desired degree the hardiness of the Malaga and the fruiting qualities of the Muscat, Muscatel, and other varieties used in the crosses. That this will ultimately do away with the losses from coulure in raisin grapes is confidently believed, and it is doubtful if there be any other satisfactory way out of the trouble.

It will require several years to grow the new seedlings to maturity, but the results of the crosses may be hastened somewhat by grafting the wood of the seedlings into mature vines. In this manner the ultimate fruit of the seedlings may be obtained at an earlier date than it could be from the young plants themselves.

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